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# (54) Electrical cable

(57) An electrical cable comprises a plurality of conductors and means supporting the conductors about and spaced from the longitudinal axis of the cable to provide a central portion devoid of conductors. In an embodiment the cable (10) comprises a hollow tube (11) made from a resilient insulator, a sheath (13) extending along the length of the tube (11), and a plurality of conductor wires (14) e.g. braided, disposed circumferentially in the space between sheath (13) and tube (11). The tube (11) is reinforced by either a coil spring (12) extending along the length of cable (10) and embedded in the wall of tube (11), or by a plurality of synthetic fibers (15) filling (Fig 2) the hollow interior of tube (11) and extending along the length of cable (10). A sheath (16) can also be formed directly over the outer periphery of tube (11) with conducting wires (14) being embedded therein (Fig 3), or a sheath dispensed with altogether with conducting wires (14) being wrapped over tube (11, Fig 4).

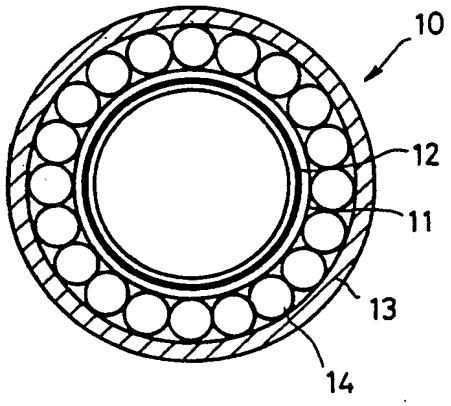


FIG. 1

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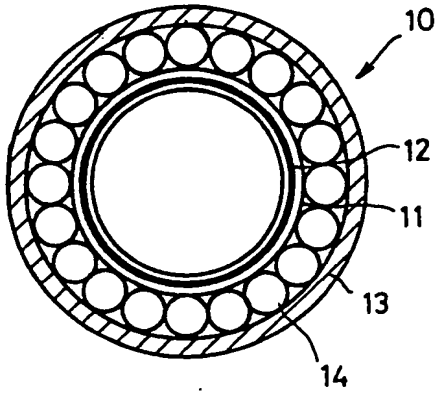


FIG. 1

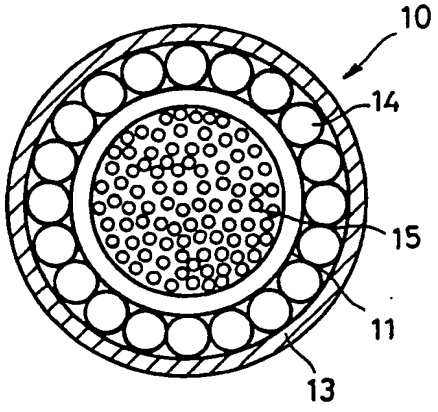


FIG. 2

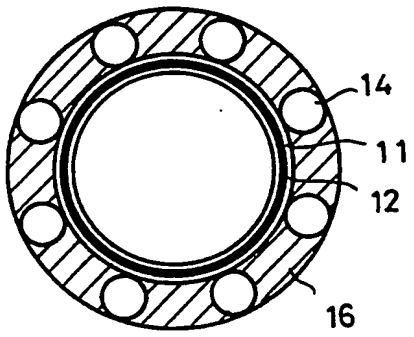


FIG. 3

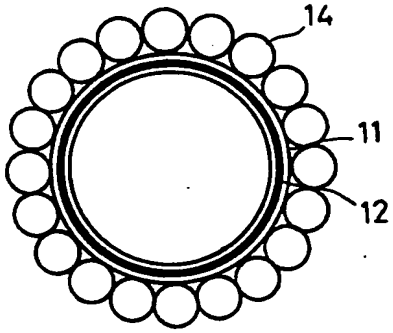


FIG. 4

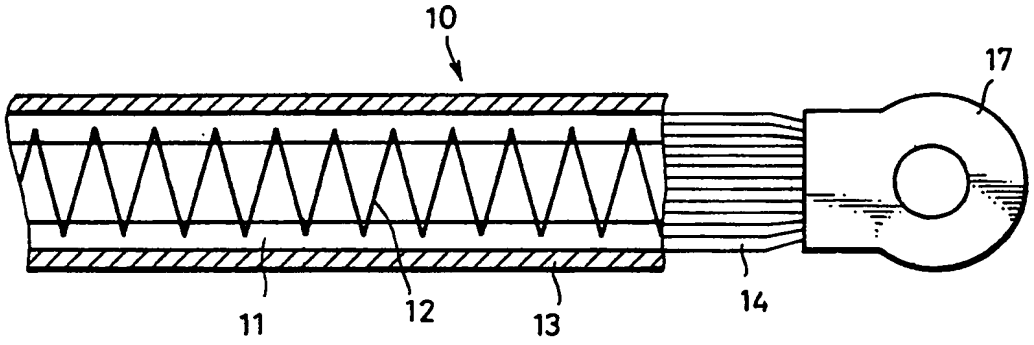


FIG. 5

SPECIFICATION:

A Structure of an Electrical Conductor

The present invention relates to an improved structure of an electrical cable, and more particularly to an improved structure of an electrical cable that more efficiently conducts alternating electrical current as compared to a conventional electrical cable with the same cross-sectional area of conductors.

In a conventional electrical cable, the bundle of conductors therein are arranged so as to have a generally circular cross-section. As such, due to the skin effect which effectively forces the current in an alternating current carrying conductor towards the surface or "skin" of the conductor, the conducting wires positioned towards the center of the conductor bundle would effectively carry less current than the conducting wires positioned near the periphery of the conductor bundle, away from the central portions thereof.

The improved structure electrical cable of the present invention, however, overcomes this deficiency in a conventional electrical cable by providing a conductor bundle arranged so as to have a generally annular cross-section, having a central portion thereof devoid of conducting wires.

With such an arrangement of conducting wires in the conductor bundle of the electrical cable of the present invention the influence of the skin effect is much reduced with the conducting wires throughout the conductor bundle carrying nearly equal currents.

Thus, the improved structure cable of the present invention would carry more current than a conventional electrical cable with an equal cross-sectional area of conductors as the average current density per unit cross-sectional area of conductor in the electrical cable of the present invention would be higher than that of a conventional electrical cable.

The structure of an electrical cable of the present invention has as a main objective to provide an electrical cable that efficiently conducts current with a minimized usage of conductor material.

The structure of an electrical cable of the present invention comprises a hollow tube made from a resilient, insulating material, a sheath disposed over the outer periphery of the hollow tube and extending along the length of the cable, and a plurality of conducting wires disposed in the space between the sheath and the hollow tube.

The hollow tube is reinforced by a metallic coil spring embedded in the wall thereof in a first embodiment of the structure of an electrical cable of the present invention, and by synthetic fibres filling the hollow interior thereof and extending along the length of the cable in a second embodiment of the structure of an electrical cable of the present invention.

In a third embodiment of the structure of an electrical cable of the present invention, the sheath is formed directly on the outer periphery of the hollow tube and is in intimate contact therewith.

Further, the conducting wires are embedded directly within the wall of the sheath, with adjacent wires being separated by a pre-determined distance therebetween.

As the conducting wires are disposed circumferentially about the hollow interior of the cable, between the sheath and hollow tube in the first and second embodiments, or within the sheath in the third embodiment, so as to have a generally annular arrangement in cross-section, the improved structure cable of the present invention can conduct electrical current more efficiently than a conventional electrical cable having a bundle of conducting wires arranged in a generally circular arrangement, with an equal cross-sectional

area of conductors, due to the skin effect which would tend to minimize the current in the conducting wires disposed towards the center of the bundle in a conventional cable.

With the conductors near the outer periphery of the conductor bundle of a conventional cable carrying current at their maximum safe current ratings, the more inwardly disposed conductors thereof would be carrying correspondingly less current than is allowed by their current ratings. Whereas, in the improved structure cable of the present invention most of the conductors would be operating near their maximum safe current ratings. Thus the improved structure electrical cable of the present invention could carry more current than a comparable conventional cable with an equal cross-sectional area of conductors.

In a fourth embodiment of the structure of an electrical cable of the present invention, the insulating sheath is dispensed with and the conducting wires are secured to the hollow tube by winding thereon.

A detailed description of the structure of various preferred embodiments of the electrical cable of the present invention are given below along with accompanying drawings, wherein:

Fig. 1 is a cross-sectional view of a first embodiment of the structure of an electrical cable of the present invention.

Fig. 2 is a cross-sectional view of a second embodiment of the structure of an electrical cable of the present invention.

Fig. 3 is a cross-sectional view of a third embodiment of the structure of an electrical cable of the present invention.

Fig. 4 is a cross-sectional view of a fourth embodiment of the structure of an electrical cable of the present invention.

Fig. 5 is a side cut-away view showing a first embodiment of the electrical cable of the present invention with the conducting wires therein secured to a lug.

Referring to the cross-sectional view of Fig. 1, a first embodiment of the structure an electrical cable 10 of the present invention comprises a hollow tube 10 made from a resilient, electrically insulating material, a metallic coil spring 12 embedded within the wall of hollow tube 11 and extending along the length of cable 10, a sheath 13 made from a resilient, electrically insulating material disposed over the outer periphery of hollow tube 11 being separated therefrom by a circumferential space and extending along the length of cable 10, and a plurality of metallic electrically conducting wires 14 disposed circumferentially in the space between hollow tube 10 and sheath 13.

Coil spring 12 within hollow tube 11 serves to strengthen the structure of cable 10, increasing its elasticity and resisting the crushing of the hollow interior thereof.

Conducting wires 14 within cable 10 can be interwoven in a braided fashion to further strengthen cable 10.

As the bundle of conducting wires 14 are arranged between sheath 13 and hollow tube 11 so as to have a generally annular cross-section, with no conductors being disposed in the hollow central portion of cable 10, the influence of the skin effect is much reduced and all conducting wires 14 can deliver current at near their maximum current ratings so that electrical cable 10 of the present invention can deliver more current than a comparable conventional electrical cable with the same cross-sectional area of conductors.

Referring to the cross-sectional view of Fig. 2, in a second embodiment of electrical cable 10 of the present invention, the hollow interior of hollow tube 11 is filled in with a plurality of natural or synthetic fibers 15 which, in substitution of coil spring 12, serves to

strengthen the structure of cable 10.

The arrangement of the bundle of conducting wires 14 is unchanged, as with sheath 13, and conducting wires 14 can also be interwoven in a braided fashion as with the first embodiment.

In a third embodiment of the electrical cable of the present invention, as shown in the cross-sectional view of Fig. 3, sheath 16 is formed directly around the outer periphery of hollow tube 11 and in intimate contact therewith, with the bundle of conducting wires 14 embedded therewithin. Each conducting wire 14 is separated from an adjacent conducting wire 14 by a pre-determined distance filled in by the resilient, electrically insulating material of sheath 16, though conducting wires 14 may also be interwoven in a braided fashion as with the previous embodiments.

The hollow interior of tube 11 in this embodiment can also be filled in with natural or synthetic fibers or a coil spring can be embedded into the wall thereof as with the previous embodiments.

In a fourth embodiment of the electrical cable of the present invention, as shown in the cross-sectional view of Fig. 4, a sheath is dispensed with all together, the conducting wires 14 being wrapped around hollow tube 11, preferably in an interwoven braided fashion, to secure thereon.

This latter embodiment of the electrical cable of the present invention is particularly suited for applications where the cable is separated from any nearby conductors, such as in the case of a hanging power distribution line.

As with the previous embodiments of the electrical cable of the present invention, the hollow interior of tube 11 can be filled in with natural or synthetic fibers or a coil spring can be embedded into the wall thereof to strengthen the structure of the cable.

Referring to the cut-away view of Fig. 5, an electrical cable 10 of the first embodiment of the electrical cable of the present invention described above is shown with a portion of sheath 13 and hollow tube 11 removed, revealing coil spring 12. Conducting wires 14 are shown extending

from an end of cable 10 to secure with a terminal lug 17.

Further variations and modifications of the improved structure electrical cable of the present invention would occur to one skilled in the art, and all such variations and modifications are deemed to be within the spirit and scope of the present invention as defined by the appended claims.

CLAIMS:

1) An improved structure of an electrical cable comprising a bundle of electrical conducting wires, wherein the improvement comprises:

a hollow tube made from a resilient, electrically insulating material;

a coil spring embedded within the wall of said hollow tube and extending along the length of said cable;

a sheath made from a resilient, electrically insulating material disposed over the outer periphery of said hollow tube and being separated therefrom by a space, extending along the length of said cable;

wherein, said conducting wires are disposed circumferentially in the space between said sheath and said hollow tube.

2) An improved structure of an electrical cable according to claim 1, wherein said conducting wires are interwoven in braided fashion.

3) An improved structure of an electrical cable comprising a bundle of electrical conducting wires, wherein the improvement comprises:

a hollow tube made from a resilient, electrically insulating material;

a plurality of natural or synthetic fibers disposed within the hollow interior of said hollow tube and substantially filling in the space therein, extending along the length of said cable;

a sheath made from a resilient, electrically insulating material disposed over the outer periphery of said hollow tube and extending along the length

of said cable, being separated from said hollow tube by a circumferential space;

wherein, said conducting wires are disposed circumferentially in the space between said sheath and said hollow tube.

4) An improved structure of an electrical cable according to claim 3, wherein said conducting wires are interwoven in braided fashion.

5) An improved structure of an electrical cable comprising a bundle of electrical conducting wires, wherein the improvement comprises:

a hollow tube made from a resilient, electrically insulating material;

a sheath made from a resilient, electrically insulating material formed around the outer periphery of said hollow tube and in contact therewith, extending along the length of said cable;

wherein, said conducting wires are embedded circumferentially within said sheath.

6) An improved structure of an electrical cable according to claim 5, wherein a coil spring is embedded within the wall of said hollow tube, extending along the length of said cable.

7) An improved structure of an electrical cable according to claim 5, wherein a plurality of natural or synthetic fibers are disposed within the hollow interior of said hollow tube and substantially fills in the space therein, and extends along the length of said cable.

8) An improved structure of an electrical cable according to claim 5,

wherein said conducting wires are interwoven in braided fashion.

9) An improved structure of an electrical cable comprising a bundle of electrical conducting wires, wherein the improvement comprises:

a hollow tube made from a resilient, electrically insulating material;

wherein said conducting wires are disposed circumferentially around said hollow tube, and wound thereon to secure therewith.

10) An improved structure of an electrical cable according to claim 9, wherein a coil spring is embedded in said hollow tube and extends along the length of said cable.

11) An improved structure of an electrical cable according to claim 9, wherein a plurality of natural or synthetic fibers are disposed within the hollow interior of said hollow tube and substantially fills in the space therein, and extends along the length of said cable.

12) An improved structure of an electrical cable according to claim 9, wherein said conducting wires are interwoven in braided fashion.

13) An electrical cable comprising a plurality of electrical conductors and means supporting said conductors about and spaced from the longitudinal axis of the cable to provide a central portion devoid of conductor wires.

14) An electrical cable substantially as hereinbefore described with reference to Figure 1 and 5 or any one of Figures 2 to 4 of the accompanying drawings.

**Patents Act 1977** - 10
**Examiner's report to the Comptroller under Section 17 (The Search Report)**

Application number

9117802.0

**Relevant Technical fields**

(i) UK Cl (Edition ) K H1A F2P (PF14)

(ii) Int Cl (Edition 5 ) H01B

Search Examiner

J L FREEMAN

**Databases** (see over)

(i) UK Patent Office

(ii)

Date of Search

12 NOVEMBER 1991

Documents considered relevant following a search in respect of claims 1 TO 2

| Category (see over) | Identity of document and relevant passages | Relevant to claim(s) |
|---|---|---|
| A | GB 2139312 A (GEOPHYSICAL COMPANY) The figure | 1,3,5, 9 and 13 |
| A | GB 1582503 A (GOODYEAR TIRE) Figures 1 and 2 | 1,3,5, 9 and 13 |
| A | GB 1578125 A (RAYCHEM CORP) Figures 1 to 3 | 1,3,5 9 and 13 |
| A | GB 1564840 A (ELECTROLUX) All figures | 1,3,5, 9 and 13 |
| A | GB 1495111 A (CONTINENTAL GUMM-WERKE) All figures | 1,3,5, 9 and 13 |
| A | GB 1421044 A (FUJIKURA CABLE) Figures 6 to 8 | 1,3,5, 9 and 13 |
| A | GB 807693 A (T CRAMNER) All figures | 1,3,5, 9 and 13 |
| A | GB 232764 A (FULLERS UNITED ELECTRIC) All figures | 1,3,5, 9 and 13 |